PRINTED CIRCUIT BOARD AND SOLDERING STRUCTURE FOR ELECTRONIC PARTS THERETO

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a printed circuit board having electric or electronic parts soldered to its circuit patterns.

2. Related Art

Electric or electronic apparatuses use printed circuit boards, which have a variety of electric or electronic parts soldered to their circuit patterns. Specifically such circuit patterns are formed by labyrinth-like copper foils and the like, each having electric or electronic parts soldered to lands with their terminals inserted in the terminal holes, which are made in the lands.

Fig.5a is a plane view of the land 51 whereas Fig.5b is a sectional view of the land 51, showing the terminal 54 of a selected electric or electronic part soldered to the land 51. The land 51 is formed on the rear side (the upper side in Fig.5b) of the substrate 50, and the land 51 has a terminal hole 52 made at its center. The land 51 is surrounded by a resist layer 53 of an insulating synthetic resin to prevent solder from attaching the surrounding area. The terminal 54 of the electric or electronic part is joined to the land 51 by solder.

As seen from Fig.5b, the solder lump 55 adhered both to the land 51 and terminal 54 looks like a cone. Its incline sides are dented, and it is small in volume or quantity compared with semi-sphere. Accordingly the cone-like solder lump 55 can hardly provide a holding strength enough to assure that the electric or electronic part be fixedly held on the printed circuit pattern. As a matter of fact, when electric or electronic device having such printed circuit boards are transported, some parts are shook to come off from their printed circuit patterns. Also, printed circuit boards are influenced by surrounding temperature variation or by temperature change caused by turning printed circuits on and off, so that some parts come off from their printed circuit patterns.

Therefore, it is necessary to locate small solder lumps for applying additional quantity of solder. This, however, is a tedious and time-consuming work.

Small solder lumps are easily overlooked. Also, it may be possible that additional quantity of solder causes short-circuiting.

In the hope of increasing the quantity of solder lump on each land JP 2000-91737(A), titled "Printed Circuit Boards and Their Manufacturing Method" (see Fig.6) has proposed use of a land comprising a center circular land and a plurality of second sector lands surrounding the first center land. The printed circuit board has electronic parts or devices borne with their terminals inserted in the terminal holes of the circular lands. Such a printed circuit board is moved to sweep on the melted solder bath, solder lumps separately built on the circular and sector lands, and then these solder lumps are joined together under the influence of surface tension to provide a large quantity of solder lump.

Fig.6a is a plane view of one example of such composite land whereas Fig.6b is a cross section of the composite land taken along the line 6(b) - 6(b) in Fig.6a. As shown, the center circular land 56 has a terminal hole 52 made at its center, and four sector lands 57 surround the first center land 56. The resist layer 58 of an insulating synthetic resin is laid on the copper foil surface, filing the inter-land zones.

Printed circuit boards each having circuit patterns printed on its opposite surfaces are often used. These circuit patterns are locally connected via copper foils applied to the inner surfaces of the terminal holes. With this arrangement the heat can be transferred from front to rear circuit pattern via the conductor linings of the terminal holes when terminals of selected parts and devices are being soldered to one of the front and rear circuit patterns. Thus, the thermal quantity available for soldering will be lower than that for soldering in a printed circuit board having a circuit pattern on one surface. Division of the land into separate sections proposed in JP2000-91737(A) is not so effective in confining the thermal energy to the limited area for soldering, and hence, in increasing the solder quantities in joining the terminal and the land.

Further, JP8-340172(A), titled "Printed Circuit Boards" has proposed a composite land comprising a center circular land and a plurality of second radial lands projecting from the first center land. The inter-radial land spaces are filled with the resist layer of insulating synthetic resin, which is laid on the copper foil of the substrate. Therefore, thermal energy is permitted to leak from the composite land contour to the underlying copper foil of the inter-radial land space.

In view of the above one object of the present invention is to provide a printed circuit board whose soldering structure permits an adequate quantity of solder to be used in soldering the terminal of the electric or electronic part to its circuit pattern, thus assuring that the solder lump be strong enough to fixedly hold the part or device on the circuit pattern. Also, another object of he present invention is to provide a soldering structure which permits an adequate quantity of solder to be used in soldering the terminal of the electric or electronic part or device to its circuit pattern, thus assuring that the solder lump be strong enough to fixedly hold the part or device on the circuit pattern.

SUMMARY OF THE INVENTION

To attain these objects a printed circuit board having circuit patterns printed thereon is improved according to the present invention in that it has a plurality of composite lands each comprising a first land having a terminal hole made at its center for inserting the terminal of a selected electric or electronic part or device, and a plurality of second lands each being contiguous to and extending outwards from the first land, and that the areas contiguous to the contours of the first and second lands have no conductive foils such as copper foils to expose the substrate surface of the printed circuit board. The exposed areas effectively prevent thermal energy from leaking outwards from the contour of the composite land when soldering an electric or electronic part or device to the composite land.

The printed circuit board may further comprise narrow resist layers formed between the exposed areas and the first and second lands.

A soldering structure for soldering electric or electronic parts to the circuit pattern of a printed circuit board is improved according to the present invention in that it has a plurality of composite lands each comprising a first land having a terminal hole made at its center for inserting the terminal of a selected electric or electronic part or device, and a plurality of second lands each being contiguous to and extending outwards from the first land, the areas contiguous to the contours of the first and second lands having no conductive foils such as copper foils to expose the substrate surface of the printed circuit board, whereby the solder lump joining the terminal of the part or device to the first land and its adjoining second lands may be shaped into a ribbed conical form having the terminal at its center and its outer ribs integrally connected to and projecting from the cone.

The soldering structure according to the present invention has substrate-exposed zones having no thermally conductive foils contiguous to the first and second lands, thus preventing leakage of thermal energy from the first and second lands. Thus, sufficient quantities of thermal energy can be confined to the limited area to assure the reliable soldering. Still advantageously, the ridged cone-like shape is useful in building up the solder lump strong enough to assure that the terminal of the part or device be fixedly gripped; the terminal can be fixedly supported by the surrounding cone-like solder lump and ridge lumps as a whole. This soldering structure requires a minimum quantity of solder material.

Other objects and advantages of the present invention will be understood from the following description of some preferred embodiments of the present invention, which are shown in accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

Fig.1a is a plane view of a composite land according to a first embodiment of the present invention; and Fig.1b is a sectional view of the composite land taken along the line "1(b)"-"1(b)" in Fig.1a;

Fig.2a is a plane view showing how the soldering lump is built on the composite land of Fig.1; and Fig.2b is a sectional view taken along the line "2(b)"-"2(b)" in Fig.2a, showing the surrounding cone-like solder lump and ridge lumps;

Fig.3 is a plane view of a composite land according to a second embodiment of the present invention;

Fig.4 is a plane view of a composite land according to a third embodiment of the present invention;

Fig.5a is a plane view showing a conventional circular land; and Fig.5b is a sectional view of the circular land taken along the line "5(b)"-"5(b)" in Fig.2a, showing the cone-like solder lump; and

Fig.6a is a plane view of a conventional composite land; and Fig.6b is a sectional view of the composite land taken along the line "6(b)"-"6(b)".

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring to Fig.1, a printed circuit board has circuit patterns printed on its substrate 1. As shown, a selected first land 3 has a through hole 2 to insert the

terminal of a selected electric or electronic part or device, and four second radial lands 4 are contiguous to the first circular land 3, extending outwards therefrom. The substrate 1 has circuit patterns printed on its opposite sides, and electric or electronic parts or devices are mounted and jointed to the composite lands with their terminals inserted in the terminal holes 2 and soldered to the composite lands.

The composite land of copper foil is connected to the underlying circuit pattern 6 on the rear side via the conductor layer 5, which is applied to the inner circumference of the terminal hole 2, as seen from Fig.1b. A selected part or device is mounted on the rear side of the substrate 1 with its terminal inserted into the terminal hole 2.

As seen from Fig.1a, the surface of the printed circuit board is locally exposed by removing conductive foils such as copper foils from the areas 8, which are contiguous to the contours of the first and second lands 3 and 4. Also, narrow resist layers 7 are formed between the exposed areas 8 and the first and second lands 2 and 3.

When soldering the terminal of the part or device to the composite land 2, 3, the thermal energy applied to the composite land is partly allowed to leak to the underlying circuit pattern 6 via the conductor layer 5 of the terminal hole 2. To compensate for the inevitable leak of thermal energy to the underlying circuit pattern, the exposed areas 8 prevents thermal energy from leaking outwards from the first and second land contours on the front side of the printed circuit board.

Referring to Fig.2, the solder lump built up on the composite land is composed of a circular cone-like lump 10 and four radial ridge lumps 9. The ridged cone-like shape has the effect of significantly increasing the strength with which the terminal of the part or device is fixedly held on the circuit pattern. The ridged cone-like lump is smaller in volume than the semi-spherical shape whose base is equal to the circular contour drawn by connecting the outer ends of the four radial ridges 9, and accordingly the solder material of the ridged cone-like lump is small in quantity, compared with the semi-spherical lump. In spite of this, the ridged cone-like shape can provide comparable holding strength.

Referring to Fig.3, another example of composite land is composed of a first land 3 having a terminal hole 2 made at its center, and opposite second lands 4a and 4b contiguous to the first land 3, extending outwards. Two sectors 8 are formed by removing the underlying copper foils to expose the surface of the

substrate 1.

Referring to Fig.4, still another example of composite land is composed of a first land 3 having a terminal hole 2 made at its center, and four second radial lands 4 contiguous to the first land 3, extending outwards. Four five-sided areas 8 each having four straight sides and one curved side are formed by removing the underlying copper foils to expose the surface of the substrate 1.

As may be understood from the above, the composite land is encircled with thermal insulating zones, which are provided by removing the copper or conductive metal layer from the selected patches, thus exposing the underlying substrate surface. This effectively prevents thermal energy from leaking outwards from the composite land contour in soldering the terminal of an electric or electronic part or device to the composite land. The resultant ridged cone-like solder lump has an increased strength to hold the terminal in the terminal hole in spite of relatively small solder quantity used.